

Microbiologically Influenced Corrosion (MIC) Frequently Asked Questions

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This page is intended to answer common questions that are routinely asked by design professionals practicing in Tennessee and to promote a better understanding of Microbiologically Influenced Corrosion (MIC) and its interaction with sprinkler systems. It is not intended to be construed as legal opinion nor legal advice and is not binding on the State Fire Marshal's Office. If you are registrant of the Tennessee Board of Architectural and Engineering Examiners, you always have the option of contacting Christy Allen, who is currently your board's attorney, through 615-741-3072 for clarifications on any questions regarding the Sprinkler Standard of Care and A&E related legal questions.

Q What is MIC?

A Microbiologically Influenced Corrosion

It is tiny little creatures living in water that can harm sprinkler systems. They are so small that you cannot see them with the naked eye.

Q Why do I care about MIC?

A MIC can harm the sprinkler system and cause the system to fail or function in a substandard fashion. Sprinkler systems have excellent track records when properly maintained, but they require periodic maintenance to ensure they will function just as designed. Since MIC can threaten functionality, we need to inspect for MIC more closely if we know the conditions are right to develop MIC or if MIC has been found in nearby systems.

Q I am building a new building that comes under the State Fire Marshal's Office for review under Tennessee Rule 0780-2-3; do I have to test for MIC?

A Only if you have a sprinkler system in your building.

Q What does the code say about MIC?

A NFPA 13 15.1.5 Water Supply Treatment, 2002 edition says "Water supplies and environmental conditions shall be evaluated for the existence of microbes and conditions that contribute to microbiologically influenced corrosion (MIC). Where conditions are found that contribute to MIC, the owner(s) shall notify the sprinkler system installer and a plan shall be developed to treat the system using one of the following methods:

- (1) Install a water pipe that will not be affected by the MIC microbes.
- (2) Treat all water that enters the system using an approved biocide.
- (3) Implement an approved plan for monitoring the interior conditions of the pipe at established time intervals and locations.

Q What does NFPA 13 15.1.5 mean?

A It means that where you know cases of microbiologically Influenced Corrosion present or have fertile environment to develop MIC, the owner has the responsibility to test and inform the designer of record. In many cases, the owner isn't a MIC expert and doesn't have the highly specialized knowledge to determine if MIC is present; however, it is his responsibility to hire competent designers as required by TCA 62-2-102 and they are expected to be competent in their respected areas. If need be, a corrective or preventative action must be implemented which very well may require modification to the sprinkler system design to mitigate the problem.

Q I have been told by my environmental or mechanical engineer that I have MIC present or the conditions that readily promote the development of MIC in my water supply; should I just scrap the idea of a sprinkler system in my building?

A No. Having MIC is not the end of the world. In many cases MIC can be controlled and corrected, and in some cases outright avoided. Even if MIC was found, it doesn't mean that it has existed long enough to compromise your sprinkler system. Like rust on your car, you need to fix it long before it gets out of control. An investment in immediate correction can reap benefits for years to come.

Q I have never had MIC before; doesn't that mean I am safe from here on out?

A No, not really. Each passing year without MIC certainly is a good sign, but it is no guarantee. The aquatic environment, utility's distribution system, and other human factors come together to create the conditions that either favor the development of MIC or impede growth. Just because the utility does a great job with the drinking water doesn't mean that under the right circumstances, MIC won't develop in your sprinkler system.

Q I have MIC in my building; are my occupants at a health risk?

A Generally no. If MIC exists to the point it compromises a sprinkler system then added threats from fire related health issues certainly exist but mostly MIC is a threat to the sprinkler system and its materials. With the use of back-flow preventers and regular replenishment of potable (fresh drinking water) there are very few health risks.

Q Can my utility system have MIC and the water still be safe to drink?

A Certainly, although many of the safeguards put in place to ensure safe drinking water control organisms that are harmful to humans when they drink the water many serve a dual purpose and kill many organisms that cause MIC, but keep in mind, some organisms can alter the aquatic environment. If for instance, a MIC microbe reduces PH significantly below 7.0 then the aquatic environment may become acidic and contribute to corrosion even though the organism no longer exists in such numbers to directly threaten

the system.

Q Where does the State Fire Marshal's Office suspect MIC is most likely to be found?

A Very early results of testing seems to suggest that established wet sprinkler systems are more likely to have MIC organisms present than the average water source.

Q Why is the water supply generally free of MIC organisms?

A The potable water supply by regulation must have some residual sanitizing agent present; for most systems, this agent is chlorine. The leftover chlorine may be referred to as "free chlorine" or "residual chlorine" because it is surplus in the water and available to kill new organisms that may try to develop. This way MIC organisms and organisms likely to harm someone by ingestion are kept under control.

Keep in mind that there are private water storage units in Tennessee that hold large volumes of water for long periods of time in areas with poor capacity or even private wells.

Most utilities have a central source of water and can be thought of similar to the hub on a wagon wheel where the water mains feed from the hub to a user some distance away. In some cases the travel distance and time are so long during times of low water consumption that the end of a line goes bad because there is too little residual chlorine to keep the water stable.

This type of scenario is more likely to happen in the winter due to water consumption patterns. Large diameter mains with relatively few users can also have similar problems. Many people refer to this type of situation as "stale water". Sometimes the water has a musky odor or feels slightly slick or in some cases may appear off color. Water companies are required to test their water periodically and try to avoid this situation. Still it occurs occasionally. If a district has identified a suspect line in their distribution, the solution is generally to install a blow-off hydrant or to flow an existing fire hydrant for some period of time to purge the line of "stale water."

Q If it is true that existing sprinkler systems are more likely to have MIC than the potable supply, why does the State Fire Marshal's Office require me to test for MIC prior to plans being approved by their office?

A First because the code (NFPA 13) requires it, and we are required to enforce the code. Second because if MIC is present or there is a fertile environment to develop MIC, the "pre-design" phase is the place to address it. Your mechanical engineer may opt for a "grid" or a "loop system" over a simple "tree" design and install large "end of line" drains which can be used to keep the stagnant water flushed out of the mains. Trying to develop a mitigation plans after the project is started is a much less desirable point.

In addition, many projects have existing systems where the sprinkler system is modified or building areas increased. Where there are multiple places to test, points inside an existing building are also required to be tested for MIC and the fertile environment for MIC development. This data can then be used to make better decisions.

Q If MIC is present or there is a fertile environment to develop MIC, what do I have to do?

A A mitigation plan must be submitted to the State Fire Marshal's Office (SFMO) and approved. Depending on the specifics such as the rate of corrosion and organisms involved the plan may be quite elaborate or very simple.

At one extreme, a simple preventive flush at scheduled times and monitoring the residual chlorine in the sprinkler system mains may then be sufficient to keep MIC from developing. Adding coupon ports (a small sacrificial piece of test metal) can then be easily pulled and examined for early signs.

At the other end, the system may need to be replaced in its entirety while the middle of the two extremes may require extended testing, chemical injection, routine monitoring of the sanitation level in the water, flushing and the adding of recirculation pumps.

Currently, SFMO requires a plan to be developed by a registrant and submitted for approval. If not otherwise controlled by law or rules, some features of the plan may be preformed by the owner or owner's representative rather than engineers or sprinkler contractors. It simply is a case by case basis and is not necessarily an expensive proposition.

Q My contractor and engineer say they have never heard of MIC, don't know what it is, and think it is a big waste of time and money; why should I be concerned?

A Microbiologically Influenced Corrosion is relatively new to many people inclusive of water utility personnel, design professionals, and contractors. That doesn't mean that it is any less real nor is that a valid reason to ignore it either. If you have a sprinkler system in your building you need it to function properly when and if it is ever called on to function. The odds may be very good that you will never have any meaningful degradation in your system to such levels that function is compromised. Human nature dictates that most people are creatures of habit and are resistant to change so some initial apprehension may be quite typical; however, complete obstinacy or an unwillingness to learn about MIC should be cause for concern.

Q What kinds of tests are required?

A There are two types of tests which fall into two categories – organic and

inorganic. Each indicates either direct evidence of the presence of MIC or there is a fertile environment to develop MIC. All tests must be performed by qualified personnel competent to conduct such testing. More information on testing labs is available by calling 615-741-7190.

Q What kinds of organic tests are required?

A Organic tests are those looking directly for living creatures such as sulfur reducing bacteria, slime forming bacteria, iron eating bacteria, coliform, aerobic/anaerobic, etc. These types of tests generally require culturing to know if they are active and represent potential direct and indirect threats to sprinkler systems.

Q What kinds of inorganic tests are required?

A Inorganic tests are those not directly looking for living creatures, but rather aquatic environmental conditions. These tests generally include PH, alkalinity, free iron and/or copper levels, Total Dissolved Solids/hardness, etc. The formation of tubercles, scaling, oxidation and electro-chemical reactions are all threats to a system.

Q What is comparative analysis and when must it be used?

A On new buildings little can be tested but the main water supply; however, on existing buildings, multiple samples from different places can be tested. Since many MIC causing organisms alter their aquatic environment, comparisons between a clean utility source and a dirty riser can indicate the type of organism and its level of activity. A slightly high PH (for example 7.5) may be normal for a given system, but if the riser tests at 6.1 then it tends toward the acidic side and may result in increased corrosion. This can be caused by living organisms. Another example would be relative changes in iron levels in different places in the system. It is the relative increase or decrease which is interpreted by a competent design professional that the comparative analysis is applied to.

Q Will CPVC piping help reduce MIC?

A There is a good possibility that MIC can be reduced by nonmetallic system materials. Unfortunately all metal cannot be removed out of a sprinkler system and sometimes, plastics/polymers are inappropriate for specific conditions. Certainly, if the iron in a steel pipe acts as a food source for a bacteria, then substitution of materials that denies the organism food is a reasonable concept. In such a case MIC may still develop at the valves and riser and at the exposed portions of the sprinkler heads themselves.

Q Are the tests currently required all we will ever need to perform?

A No. As the sprinkler industry, scientists, design community, code authors, jurisdictions and we gain more knowledge and increase understanding, the State Fire Marshal's Office (SFMO) may add or remove required tests. Each test must have scientific relevance and benefit. If a test is found to be

unreliable, poor indicator or grossly cost-ineffective, then the SFMO will move to drop it. If new tests are developed or the collective knowledge base shifts, additional or replacement tests may be required.

Q Why am I required to add the MIC tests directly in my plans?

A You must add the data into plans for the same reason you must show water flows or structural elements or site information; because the resulting building or structure will impact occupants' lives and proper design depends on complete, accurate documentation of the various variables. The state will also maintain archives of approved plans. These plans are public record and subject to re-examination in the future.

Q Will the State Fire Marshal's Office recommend a testing lab?

A No, but we have established criteria for what we will expect from a lab and may have a list of acceptable nationally recognized labs or SFMO approved labs. This office, the owners, contractors, underwriters and design professionals will depend on the accuracy of the data generated from the required tests. Fly-by-night or otherwise disreputable testing labs and personnel must be avoided for obvious reasons. We require scientific sampling, testing, evaluation, presentation and interpretation and reject in-field observation like "it smells or looks OK." Similarly we will not accept any "to the best of my knowledge" letters.

Q Why will the State Fire Marshal's Office not accept "to the best of my knowledge" and similar letters as would seem to be allowed by NFPA 13's Annex A?

A First, the SFMO has not adopted the annex, but does regularly look at the annexes in various codes and standards for guidance.

Secondly, the annex of NFPA 13 doesn't really allow "to the best of my knowledge" letters. What it says in part is "Evaluation of the water supply and environmental conditions does not necessarily require a water sample analysis by a laboratory. Instead, general knowledge of the long-term condition of sprinkler systems with similar piping materials in similar environments on the same water supply can be a sufficient evaluation."

Unless you have specifically had a water supply tested for MIC and then followed several specific systems of similar materials, you have no "general knowledge". In reality, what you have is "no knowledge" and that is exactly what a "to the best of my knowledge" letter says – "I don't know of any problems."

Q How is it that the State Fire Marshal's Office can use the annex in one case and not in another?

A The State Fire Marshal's Office (SFMO) is not bound to accept any annex or commentary. The annexes are not directly adopted while the codes and

standards are. The SFMO is the authority having jurisdiction (AHJ) whose primary code is the Uniform Fire Code/NFPA 1 which charges this office with the responsibility of fire and life safety through the use not just of code but the interpretation of code and code intent.

NFPA 1 2003 edition, 4.5.1.1 states "The AHJ shall determine whether the provisions of this Code are met."

NFPA 1 2003 edition, 4.5.1.2 "Any requirements that are essential for the safety of building occupants and are not specifically provided for by this Code shall be determined by the AHJ."

NFPA 1 2003 edition, 4.4.6 and NFPA 101 2003 edition 4.5.6 both state "System Design/Installation. Any fire protection system, building service equipment, feature of protection, or safeguard provided for life safety shall be designed, installed, and approved in accordance with applicable NFPA codes and standards." Of which NFPA 13 is one such code and/or standard.

NFPA 1 2003 edition, 1.7.10 says "Plans and Specification. The AHJ shall have the authority to require plans and specifications to ensure compliance with applicable codes and standards."

And probably most important, NFPA 1 2003 edition 1.3.2.3 specifically says "Nothing herein shall derogate from the authority of the AHJ to determine compliance with codes or standards for those activities or installations within the AHJ's responsibility." So even if the annex directly conflicted with the code, code's intent or SFMO's interpretation of the code's intent such an annex or part thereof can be completely rejected by the AHJ.

Q Why is it that the annual flow tests can't keep the riser's water from growing stale?

A The "inspectors test" port is not a "flush" valve. The purpose is to flow the same amount of water as would flow if the stingiest sprinkler head went off. Doing so, the inspector can tell if the water flow switch will signal the alarm and the alarm emergency forces. It simply isn't intended to flow large volumes of water in a short period. Keep in mind that a 6 inch line holds approximately 1-1/2 gallons of water per linear foot of pipe. The system may hold quite a bit of water.

Q Could an "end of line flush valve" be added to my system?

A Yes, by the right people. Do keep in mind the owner must be educated in his own system more so with MIC present because installation of a flush valve (if operated) will definitely bring the fire department running; however, it is reasonable that a system could be flushed annually by the sprinkler contractor/fire inspector when the inspector's test is cycled.

Q Can a “dry pipe” or “pre-action” system be used in place of a standard “wet pipe” system?

A Yes, in many cases, but they are generally more complicated than wet pipe systems. The fewer parts/simpler design that a wet pipe system can offer also means inherently easier maintenance and could be a little more dependable in certain cases.

Q Can standpipes be affected by MIC?

A Sure, leaks can develop in standpipes too, but one primary complication in sprinkler systems and another is that sprinkler nozzles/orifices can be occluded (plugged). You are pretty safe assuming MIC won't plug a hose connection, but it is reasonable that MIC could seize valves and/or hose connection caps particularly if the valve seat leaks a bit and allows water to be trapped on the hose side of the valve.

Q This MIC thing sounds like a lot of trouble; what if I decide just not to sprinkle my building?

A First, you may not have that option. Your building's height or area limitation may require a sprinkler system. In addition the occupancy itself may require a sprinkler system not to mention insurance companies may require one as a term of their underwriting or offer a discount for a system.

Second, the State Fire Marshal's Office isn't in the pattern of suggesting sprinklers not be used and a sprinkler system will dispense the same material the responding fire department will use in the event of fire. Sprinklers save lives and property.

Q What is a “BART” test?

A BART is an acronym for Biological Activity Reaction Test. The State Fire Marshal's Office (SFMO) does not specifically require a BART. BART refers to a test method and generally produces positives or negatives and may not produce well quantified analysis. A color change from perfectly clear to blue may be a “positive” but quantifying “how blue” may require a personal interpretation in visual comparison to a “known color scale”. A false negative can be as bad as a false positive.

A floating ball may be placed inside of a test tube as a surface area. If a slime forming bacterial sets up a massive colony then a visible film however “how much slime” may be more difficult to judge. Tests will vary in the quantification and even the value of quantification. For many a simple yes or no may be all that is required.

The SFMO encourages as many quantified tests as possible especially when planning a course of mitigation or forecast. A great deal of professional laboratory and environmental expertise will likely be required in interpretation of test results. This is why a quality lab and registrant are critical to a course

of action.

Q My contractor tells me he can smell MIC; will you accept a letter from him in place of a laboratory and registrant's report on findings?

A No, certainly there are indicators by feel, smell or visual characteristics in extreme cases and can be accepted as a red flag, but the absence of such indicators cannot guarantee no MIC causing organisms are present.

Q How important are the qualifications of my lab and sampling technician?

A They are critical. Improper handling can lead to false positives and false negatives the implications of which are obvious.